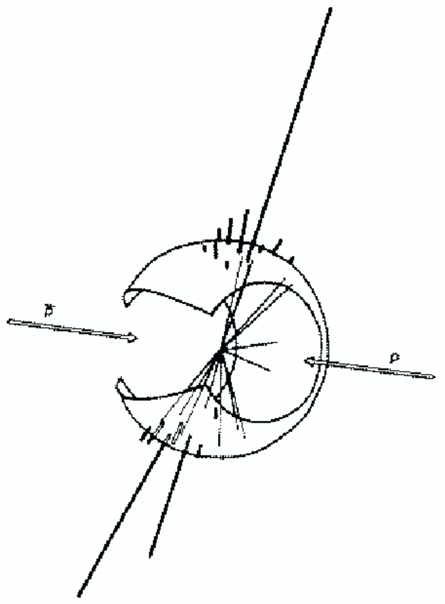
The jet fragmentation in pp and AuAu collisions at $\sqrt{s_{NN}}$=200 GeV



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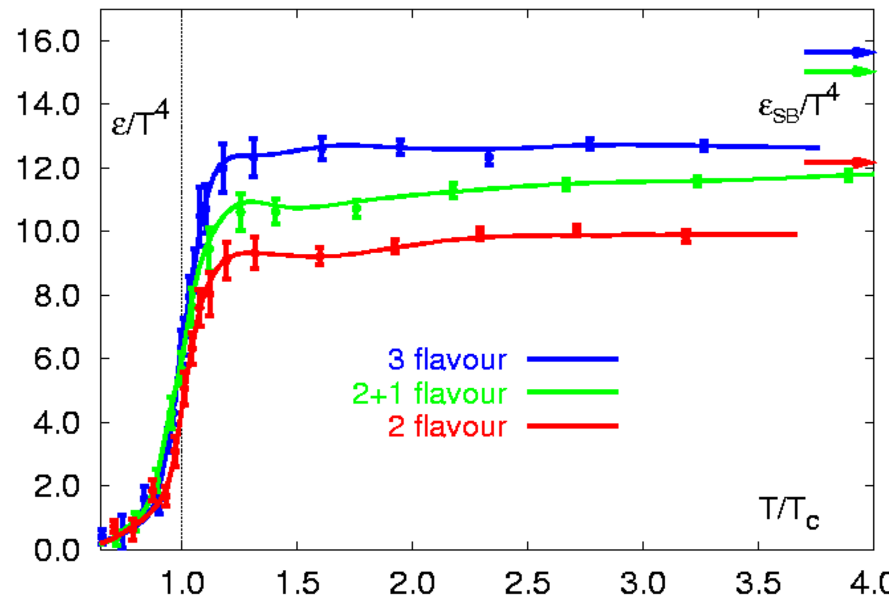
sQGP

Main RHIC results from AuAu data

(with us since SB QM01)

- Strong high-p_T yield suppression.
- Back-to-back jet disappearance.
- Large azimuthal anisotropies.

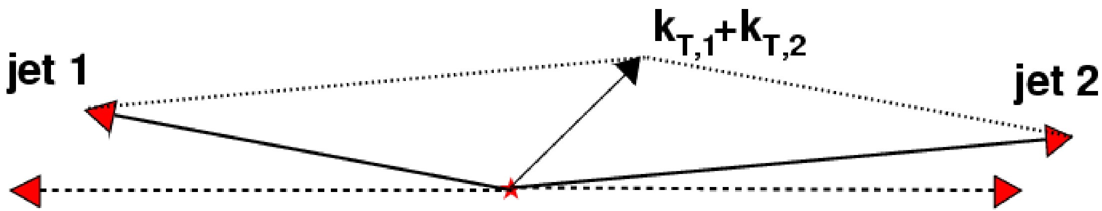


Lattice QCD, *Lect. Notes Phys* ***583***, *209 (2002)*

Modification of parton properties due to their interactions with QCD medium

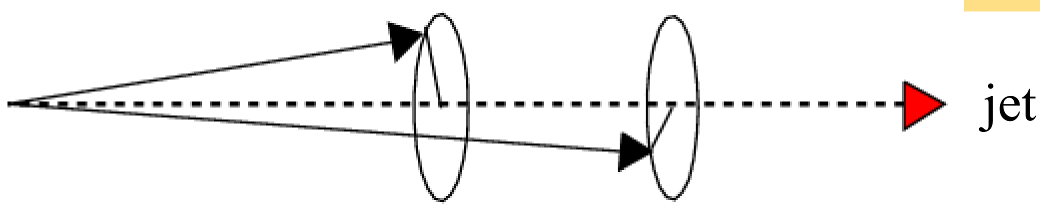
- parton "intrinsic" transverse momentum k_T
- Jet shape – jet transverse fragmentation momentum j_T
- Parton distribution function
- Fragmentation function

k_T, j_T



Partons have to materialize (fragment) in colorless world

$\vec{j}_T$ = jet fragmentation transverse momentum

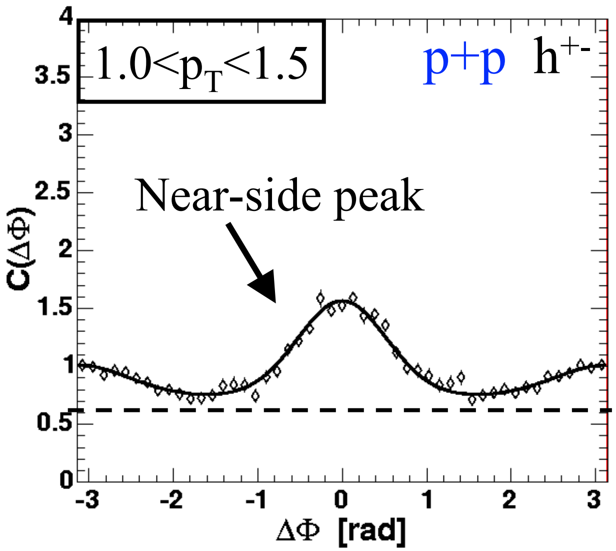


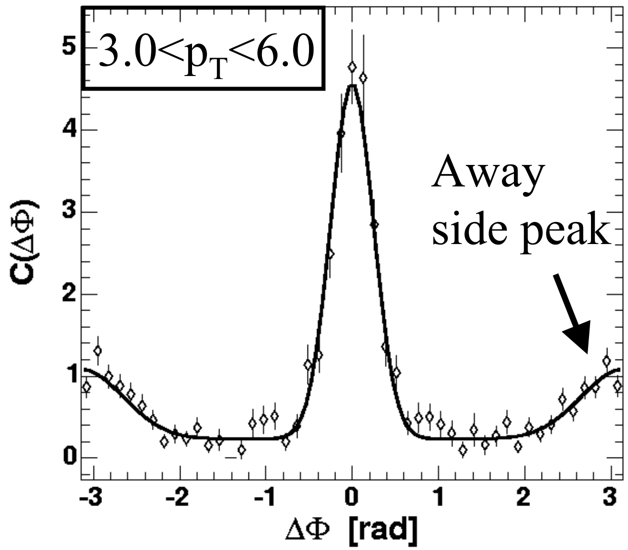
$\langle|j_{Ty}|\rangle$ is an important jet parameter. It's constant value independent on fragment's p_T is characteristic of jet fragmentation (j_T-scaling).

$\langle|k_{Ty}|\rangle$ (intrinsic + NLO radiative corrections) carries the information on the parton interaction with QCD medium.

$$\langle k_\perp^{\ 2}\rangle_{AA} = \langle k_\perp^{\ 2}\rangle_{vac} + \langle k_\perp^{\ 2}\rangle_{IS\ nucl} + \langle k_\perp^{\ 2}\rangle_{FS\ nucl}$$

pp and dAu correlation functions



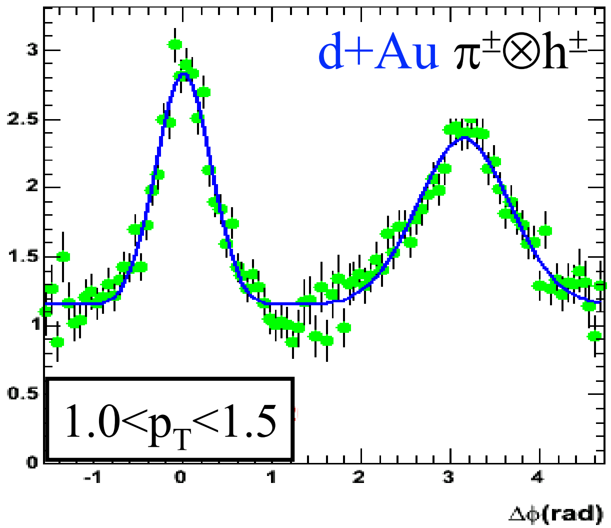


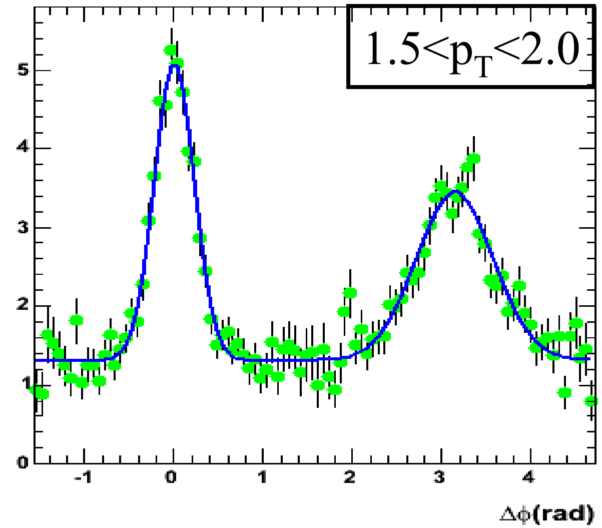
Fixed correlation:

both p_{Ttrigg} and p_{Tassoc} are in the same range

Assorted correlation:

p_{Ttrigg} and p_{Tassoc} different





$5.0<p_{Ttrigg}<16.0$ GeV/c

Jet function assumed to be Gaussian

$$C_{ij}(\Delta\phi) = norm \cdot \frac{dN^{real}_{ij}}{d\Delta\phi_{ij}} \bigg/ \frac{dN^{mixed}_{ij}}{d\Delta\phi_{ij}}$$

$$\text{Fit} = \text{const} + \text{Gauss}(0) + \text{Gauss}(\pm\pi)$$

σ_N, σ_A , $\langle|j_{Ty}|\rangle$, $\langle|k_{Ty}|\rangle$ relations

Knowing σ_N and σ_A it is straightforward to extract $\langle|j_{Ty}|\rangle$ and $\langle z_{trigg}\rangle\langle|k_{Ty}|\rangle$

In the high-p_T limit ($p_T \gg \langle|j_{Ty}|\rangle$ and $p_T \gg \langle|k_{Ty}|\rangle$)

$$\left\langle\left|j_{\perp y}\right|\right\rangle = \langle p_\perp\rangle \sin\frac{\sigma_N}{\sqrt{\pi}}$$

$$\left\langle\left|k_{Ty}\right|\right\rangle \approx \langle p_T\rangle\sqrt{\sigma_A^2 - \sigma_N^2}$$

However, inspired by Feynman, Field, Fox and Tannenbaum (see *Phys. Lett. 97B (1980) 163*) we derived more accurate equation

$$\boxed{\langle z_{trigg}\rangle\langle|k_{Ty}|\rangle = \frac{1}{\sqrt{2}\,x_h}\sqrt{\langle p_T\rangle^2\sin^2\sqrt{\frac{2}{\pi}}\sigma_A - (1+\langle x_h\rangle^2)\langle|j_T|\rangle^2}}$$

$x_h = p_{T,assoc} / p_{T,trigg}$

"Effective" parton distribution function in pp

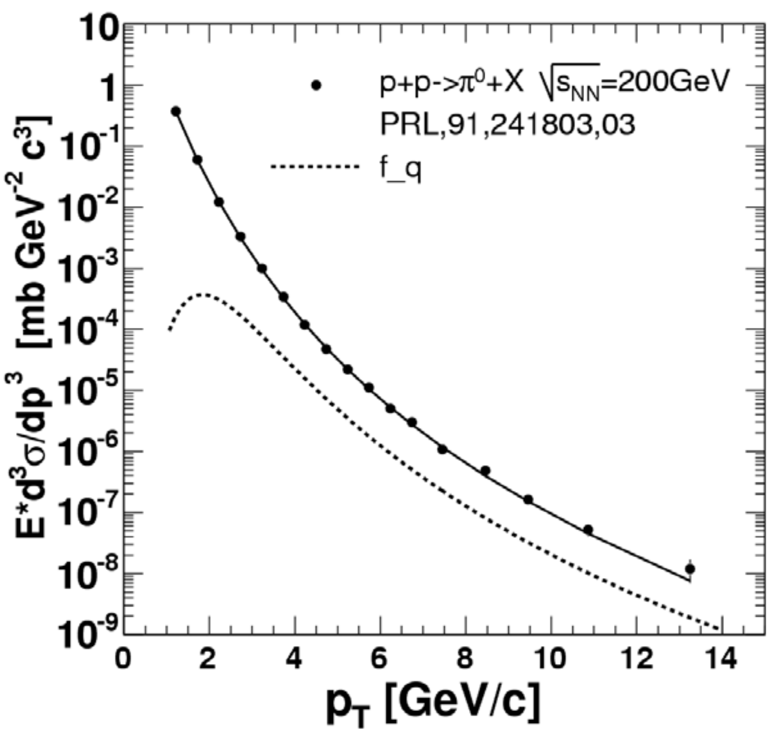
$$f_q(p_{Tq}) \propto \frac{(1-(2p_{Tq}/\sqrt{s})^2)^8}{(M_0^2 + {p_{Tq}}^2)^{n/2}}$$

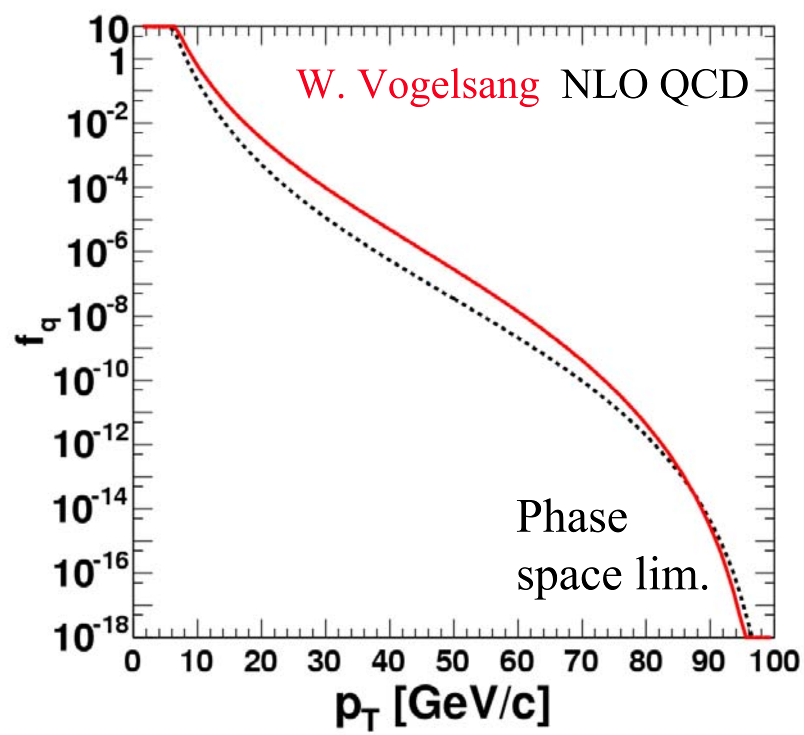
$$M_0 = \frac{m_0}{\ln(p_{Tq}/\lambda)}$$

$$\frac{d\sigma^{\pi 0}}{p_T dp_T} = \int_{x_{Ttrigg}}^{1} D(z)\cdot f_q(p_T/z)\cdot z^{-2} dz$$

Final state parton distrib. fcn = $\Sigma d\sigma_i /dt$

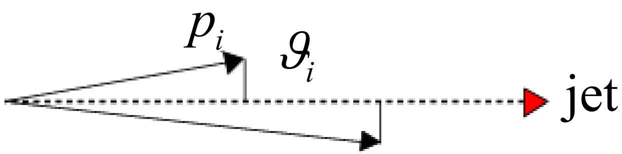
$qq \rightarrow qq$
$qg \rightarrow qg$
$q\bar{q} \rightarrow q\bar{q}$





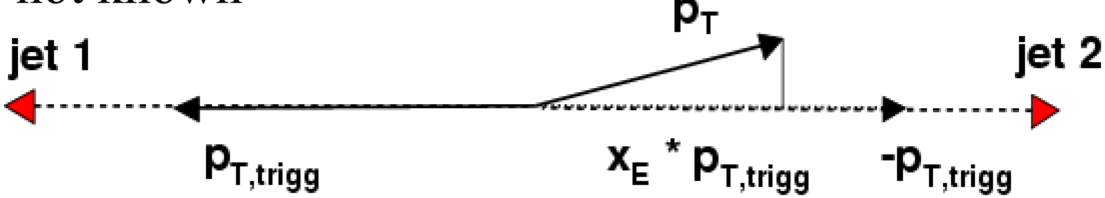
Fragmentation Function from x_E distribution

$$z_i = \frac{|\vec{p}_i|\cos(\vartheta_i)}{|\vec{p}_{parton}|} \qquad \sum_i z_i = 1$$



In Practice parton momenta are not known

$$x_E = -\frac{\vec{p}_T \cdot \vec{p}_{Ttrigg}}{|\vec{p}_{Ttrigg}|^2}$$

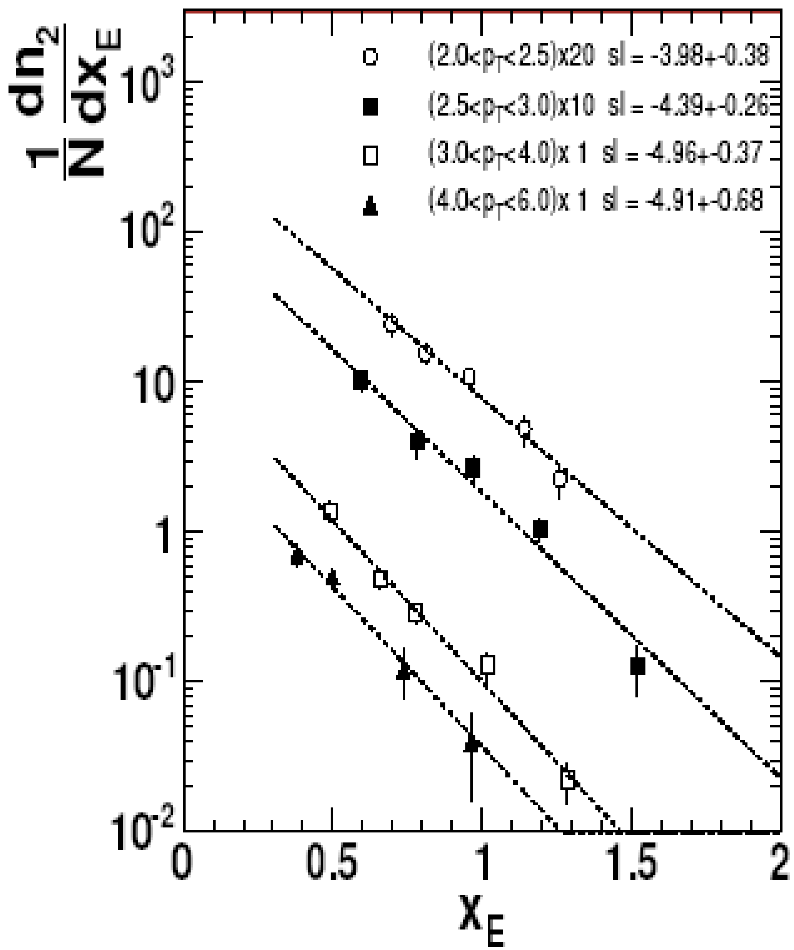


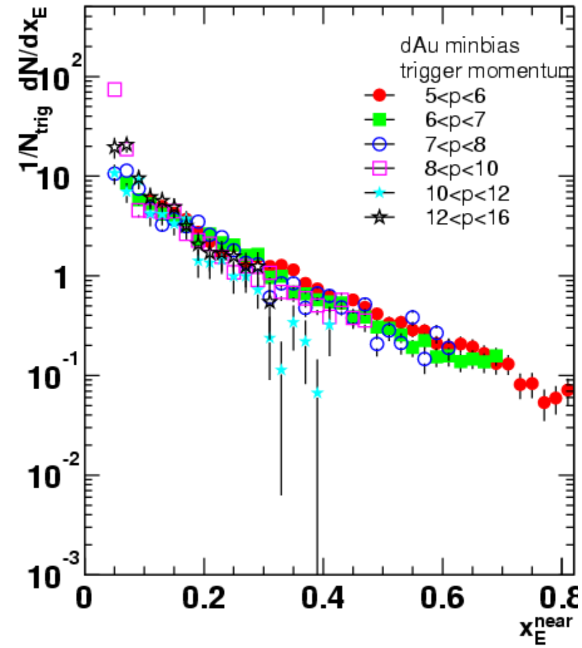
$$x_E z_{trigg} = \frac{p_T \cos(\Delta\varphi)}{p_{parton}} = z$$

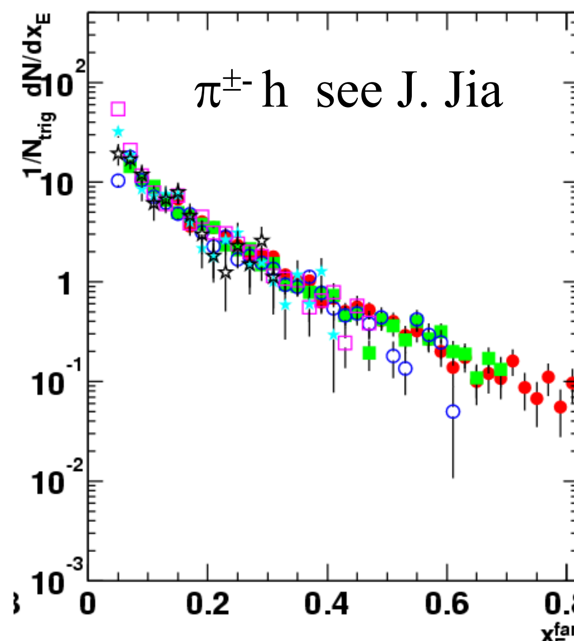
$\Rightarrow$ Simple relation $\boxed{\langle z \rangle = \langle x_E \rangle \langle z_{trigg} \rangle}$

x_E in pp collisions

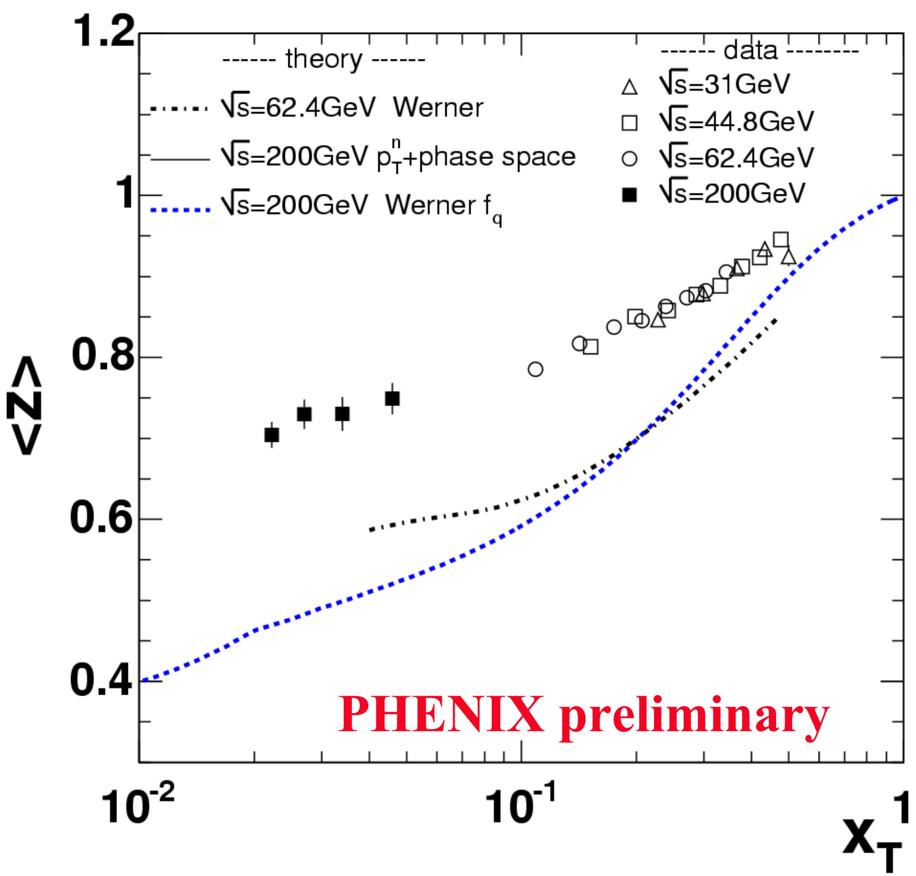
PHENIX preliminary

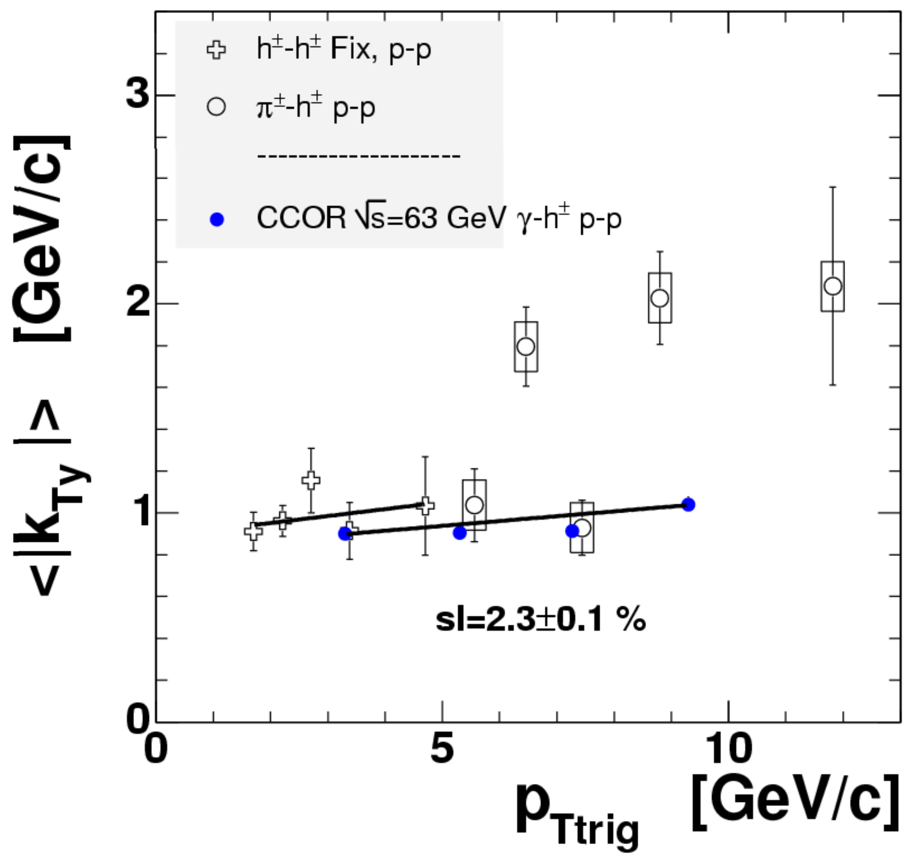






<z> correction





AuAu $\langle|j_{Ty}|\rangle$ and $\langle z\rangle \langle|k_{Ty}|\rangle$ from CF

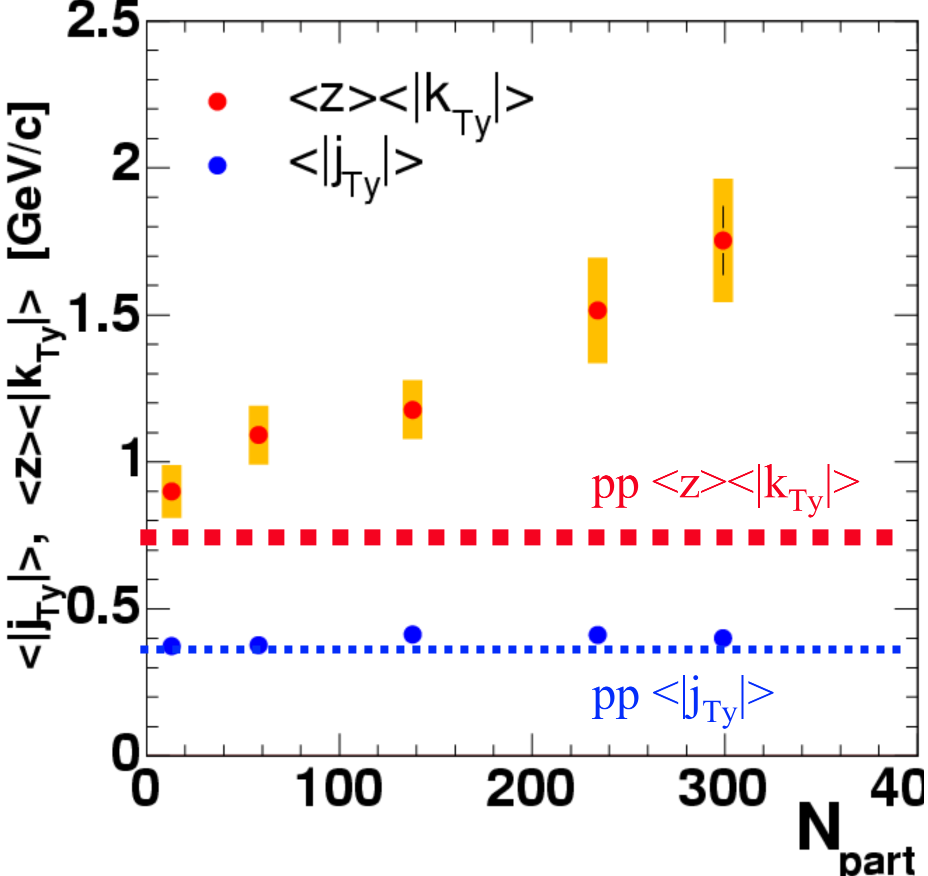
Jana Bielcikova

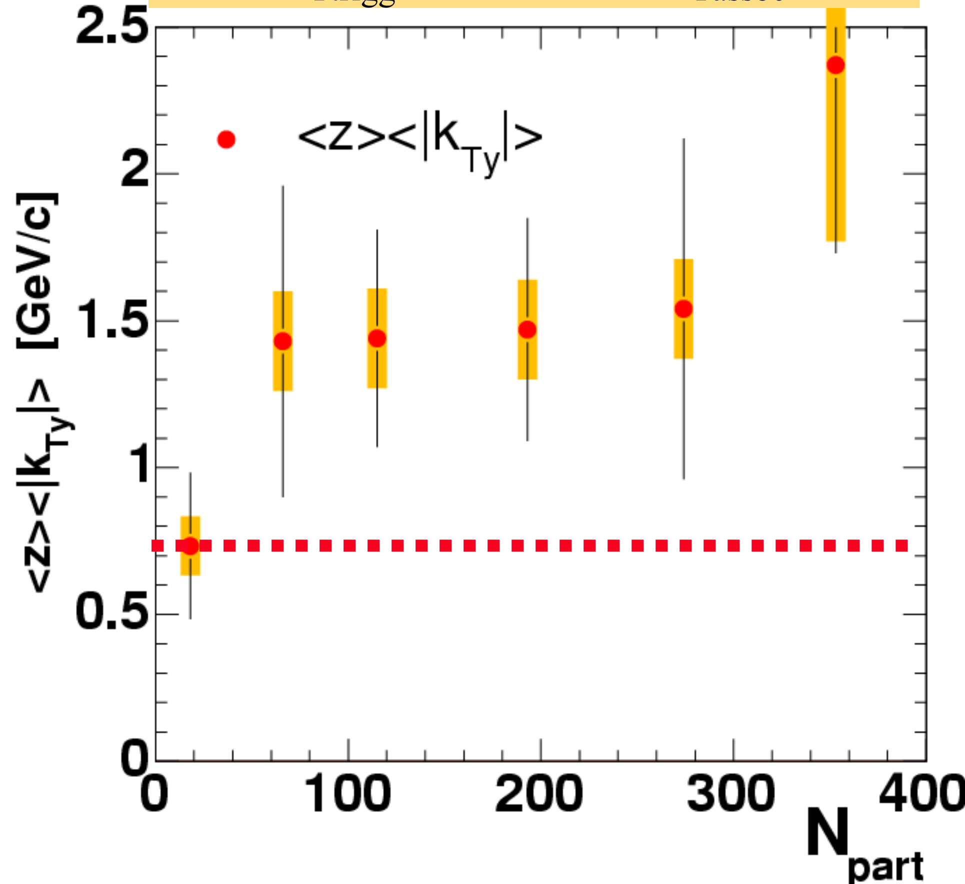
Phys.Rev.Lett.92:032301,2004

$$\langle k_\perp{}^2\rangle_{AA} = \langle k_\perp{}^2\rangle_{vac} + \langle k_\perp{}^2\rangle_{IS\ nucl} + \langle k_\perp{}^2\rangle_{FS\ nucl}$$

$(2.5<p_{Ttrigg}<4.0)\otimes(1.0<p_{Tassoc}<2.5)$

$(3.0<p_{Ttrigg}<5.0)\otimes(1.5<p_{Tassoc}<3.0)$





There seems to be significant broadening of the away-side correlation peak which persists also at somewhat higher p_T range.

Summary and conclusions

Jet production and fragmentation:

- Good agreement of the jet properties in pp collisions with other lower $\sqrt{s}$ experiments
- dAu j_T and k_T consistent with pp
- In AuAu significant broadening of "effective" k_T - with centrality
- The pp reference understood, the analysis of 280 μb^{-1} AuAu run-04 data is ongoing.